

CLAIMS

Having described the preferred embodiments, the invention is now claimed to be:

1. A radio frequency coil (44, 44', 44'', 144, 154) comprising:
a substrate (72);
a radio frequency antenna (90) disposed on the substrate (72); and
an electronics module (78, 78') disposed on the substrate (72) and electrically
5 connected with the radio frequency antenna (90).

2. The radio frequency coil (44, 44', 44'', 144, 154) as set forth in claim 1,
wherein:
the electronics module (78, 78') is disposed on a central region (96) of the substrate
(72); and
10 the radio frequency antenna (90) includes a conductor disposed on the substrate
(72) outside of and at least partially surrounding the central region (96) of the substrate
(72).

3. The radio frequency coil (44, 44', 44'', 144, 154) as set forth in claim 2,
wherein the conductor of the radio frequency antenna (90) comprises:
15 a conductive film disposed on the substrate (72) defining at least one conductive
loop (90) substantially surrounding the central region of the substrate (72), ends (100) of
said at least one conductive loop (90) extending into the central region (96) of the substrate
(72) and connecting with the electronics module (78, 78').

4. The radio frequency coil (44, 44', 44'', 144, 154) as set forth in claim 3,
20 wherein the substrate (72) comprises:
a flexible electrically insulating material.

5. The radio frequency coil (44', 144, 154) as set forth in claim 3, wherein the
electronic module (78') comprises:
printed circuitry (110) disposed on the substrate (72); and
25 one or more discrete circuit components (112, 114, 116) electrically connected via
the printed circuitry (110).

6. The radio frequency coil (44'', 144, 154) as set forth in claim 2, further comprising:

at least one spacer element (130) disposed between the substrate (72) and the electronics module (78), the at least one spacer element (130) defining a spacing (D_{spc}) between the electronics module (78) and the radio frequency antenna (90).

7. The radio frequency coil (44'', 144, 154) as set forth in claim 6, wherein the spacing (D_{spc}) is at least about one-fifth of a lateral dimension (W_{ant}) of radio frequency antenna (90).

8. The radio frequency coil (44, 44', 44'', 144, 154) as set forth in claim 2, wherein the electronics module (78, 78') has a lateral dimension (W_{elec}) that is less than or about three-fifths of a lateral dimension (W_{coil}) of the radio frequency antenna (90).

9. The radio frequency coil (44, 44', 44'', 144, 154) as set forth in claim 1, wherein the electronic module (78, 78') comprises:

a wireless transmitter (116, 126) transmitting a transmission signal representative of a radio frequency signal received by the radio frequency antenna (90).

10. The radio frequency coil (44, 44', 44'', 144, 154) as set forth in claim 1, wherein the electronic module (78, 78') comprises:

a one or more noisy circuit components (114) generating substantial radio frequency interference;

one or more quiet circuit components (112, 116) not generating substantial radio frequency interference; and

a radio frequency shield (120) disposed around the one or more noisy circuit components (114) but not around the one or more quiet circuit components (112, 116).

11. The radio frequency coil (44, 44', 44'', 144, 154) as set forth in claim 10, wherein:

the radio frequency antenna (90) defines a loop surrounding a central region (96) of the substrate (72); and

the radio frequency shield (120) is disposed substantially centered in the central
55 region (96) of the substrate (72).

12. The radio frequency coil (44, 44', 44'', 144, 154) as set forth in claim 1,
wherein the electronic module (78, 78') does not include a ground plane.

13. The radio frequency coil (44, 44', 44'', 144, 154) as set forth in claim 1,
wherein inductors (112) of the electronic module (78, 78') are selected from a group
60 consisting of:

toroidal inductors (112), and
solenoidal inductors with balanced turns.

14. A radio frequency coils array (40, 140, 150) comprising:
a plurality of radio frequency coils (44, 44', 44'', 144, 154) as set forth in claim 2
65 arranged such that the radio frequency antennae (90) of the plurality of radio frequency
coils (44, 44', 44'', 144, 154) span a coil array surface.

15. The radio frequency coils array (40) as set forth in claim 14, wherein the
substrates (72) of at least some of the plurality of radio frequency coils (44, 44', 44'') are
tilted with respect to the substrates (72) of other coils of the plurality of radio frequency
70 coils (44, 44', 44'') such that the coil array surface is non-planar.

16. The radio frequency coils array (40, 150) as set forth in claim 14, wherein at
least one coil of the plurality of radio frequency coils (44, 44', 44'', 154) is entirely
surrounded by other coils of the plurality of radio frequency coils (44, 44', 44'', 154).

17. The radio frequency coils array (40, 150) as set forth in claim 14, wherein
75 the plurality of radio frequency coils (44, 44', 44'', 154) are arranged in an N×M array
where N>2 and M>2.

18. The radio frequency coils array (40, 150) as set forth in claim 14, wherein at
least some of the coils of the plurality of radio frequency coils (44, 44', 44'', 154) share a
common substrate.

80 **19.** A magnetic resonance imaging system comprising:
 a main magnet **(20)** producing a substantially temporally constant main magnetic
field within a field of view;
 magnetic field gradient coils **(30)** that impose selected magnetic field gradients on
the main magnetic field within the field of view;
85 a means **(32, 54)** for applying a radio frequency pulse to the field of view; and
 at least one radio frequency coil **(44, 44', 44'', 144, 154)** as set forth in claim 1
arranged to detect a magnetic resonance signal induced by the applied radio frequency
pulse.

20. A magnetic resonance imaging method comprising:
90 exciting magnetic resonance in an imaging subject **(16)**; and
 receiving a magnetic resonance signal using one or more radio frequency coils **(44,**
44', 44'', 144, 154) as set forth in claim 1 with the radio frequency antenna **(90)** of each
coil in proximity to the imaging subject **(16)**.